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Enabling Disaster Relief Supply Chain Visibility (SCV) and Supply Chain Coordination (SCC)

Full Paper

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Abstract

In disaster relief-humanitarian logistics (DRHL), supply chain visibility (SCV) and supply chain coordination (SCC) remain crucial to supply chain performance, when demand and lead times are volatile. Many DRHL solutions based on operations research or other such models in the literature rely on SCV and SCC. However, there is a paucity of literature on how to enable SCV and SCC, immediately after any disaster strikes. This paper proposes a decentralised, peer–to–peer (P2P) systems architecture (SA) that augments existing information systems and communications networks in use. This architecture has additional capabilities that enable a 'low cost version' of SCV and SCC. By identifying the antecedents and characteristics of agile and quick response supply chain and introducing them into the DRHL environment, we lay the framework for enabling SCV and SCC in the DRHL environment. Based on this completed research on the systems architecture and framework, this paper outlines briefly, an implementable version of an artifact for such deployment.

Keywords

Systems Architecture (SA), Supply Chain Visibility (SCV), Supply Chain Coordination (SCC), Information Sharing, Peer–to–Peer (P2P) Networks

Introduction

Supply chain visibility (SCV) and supply chain coordination (SCC) has long been accepted as essential components to reducing supply chain (SC) volatility and improving SC performance (e.g. Lee et al., 1997; Lee & Whang, 2000, Francis, 2008), and they are especially critical to disaster relief (e.g. Ngwenya & Naude, 2016). Disaster relief humanitarian logistics (DRHL) is a difficult environment for SC operations (e.g. Taylor & Pettit, 2009; Oloruntoba & Gray, 2009; Holguín–Veras et al., 2012), with solutions to SCV and SCC being limited in scope and effectiveness in comparison with their commercial counterparts (e.g. Carroll & Neu, 2009). However, SCV and SCC remain as elusive as ever outside of the largest and most well–funded non–governmental organisations (NGOs). This research attempts to introduce the antecedents to DRHL to enable SCV and SCC and lead to improvements in SC performance, subsequently saving lives. Current academic research suffers from some common shortcomings: (1) They rely on information accuracy and visibility that is in seriously short supply (e.g. Caunhye et al., 2012); (2) They rely on wholesale adoption of new technologies without any provisions for anything short of widespread adoption (e.g. Haugstveit et al., 2015); (3) They rely on a centralised, 'military–style' command and control (C2) system (e.g. Patel, 2009) in an environment that is highly decentralised (e.g. Holguín–Veras et al., 2012); (4) They rely on systems that require significant user training (e.g. Howitt & Leonard, 2006), expense (e.g. Day et al., 2009), and risk to implement in an environment critically short of funding targets (Thomas & Kopczak, 2005). These shortcomings serve as the motivation for this paper, which aims to answer the following research questions: (1) What are the antecedents to SCV and SCC compared to the challenges in the DRHL environment; (2) Can the introduction of these antecedents enable SCV and SCC in the DRHL environment; and (3) Can a systems architecture be designed to overcome common shortcomings in related solutions that make their implementation impracticable?

Characteristics of Supply Chain Strategy		Characteristics of the Disaster Relief Environment					
		Lack of Information Visibil Day et al. (2009), Kovács & Spens (2009), Charles et al. (2010), Holguín-Veras et al. (2012)	**Lack of Coordination** Kovács & Spens (2009), Holguín-Veras et al. (2012)	**Lack of Resources** Oloruntoba & Gray (2006), Kovács & Spens (2009)	**Lack of Trust** Day et al. (2009), Büscher et al. (2014), Petersen et al. (2015)	**Unstable Environment** Oloruntoba & Gray (2006), Carroll & Neu (2009), Kovács & Spens, (2009), Charles et al. (2010), Holguín-Veras et al. (2012)	**Material Convergence** Kovács & Spens (2009), Holguín-Veras et al. (2012)
Agile	**Partnerships** Christopher (2000), Yusuf et al. (2004), Ismail & Sharifi (2006), Baramichai et al. (2007)	Limited information sharing (e.g. Day et al., 2009)	Lack of coordination even with centralised coordination agencies (e.g. Gatignon et al., 2010)	Partnerships can compromise independence and monopolise power (e.g. Patterson et al., 2010)	Competition between agencies (e.g. Banomyong et al., 2009)	Corporate partnerships can leverage private sector expertise and efficiency (e.g. Thomas & Fritz, 2006)	Inform public of inappropriate donations through media (e.g. Holguín–Veras et al., 2012)
	Information Technology (IT) Integration Christopher (2000), Yusuf et al. (2004), White et al. (2005), Ismail & Sharifi (2006), Agarwal et al. (2007), Baramichai et al., (2007), Swafford et al. (2008), Ngai et al. (2011)	Lack of IT use (e.g. Thomas & Kopczak, 2005)	Lack of IT leads to lack of coordination (e.g. Careem et al., 2007)	Lack of funding to pursue IT projects (e.g. Thomas & Kopczak, 2005)	Issues about access and power (e.g. Stephens & Ford, 2014)	Slow adoption (e.g. Andresen & Nilsson, 2014)	–
	Supply Chain Flexibility (SCF) Ismail & Sharifi (2006), Swafford et al. (2006), Baramichai et al. (2007), Swafford et al. (2008), Ngai et al. (2011)	Standardised items (e.g. USAID, 2011) and postponement (e.g. Scholten et al., 2010)	Pre–positioning supplies (e.g. Bozkurt & Duran, 2012)	Resource pooling (e.g. Kovács & Tatham, 2009) and centralised warehousing (e.g. Beamon & Balcik, 2008)	Public–private partnerships (e.g. Thomas & Fritz, 2006)	Standardised items (e.g. USAID, 2011) and postponement (e.g. Scholten et al., 2010)	Identification of high and low priority items (e.g. Holguín–Veras et al., 2012)
	Process Integration Christopher (2000), Ismail & Sharifi (2006), Agarwal et al. (2007)	Limited information sharing (e.g. Day et al., 2009) and lack of common logistics standards (e.g. Schulz & Blecken, 2010)	Standardised logistics procedures (amongst larger NGOs) (e.g. USAID, 2011)	Lack of funding to pursue process engineering and lack of professionalism (e.g. Thomas & Kopczak, 2005)	–	Processes are commonly ad hoc (e.g. Tatham & Pettit, 2010)	–
	Market Sensitivity Christopher (2000), Agarwal et al. (2007)	Information largely inaccessible (e.g. Sheu, 2007)	Information inaccessible (e.g. Sheu, 2007) but limited information sharing (e.g. Kovács & Spens, 2009)	Inform public of inappropriate donations through media (e.g. Holguín–Veras et al., 2012)	Limited information sharing (e.g. Day et al., 2009)	Lack of information visibility (Day et al., 2009)	Inform public of inappropriate donations through media (e.g. Holguín–Veras et al., 2012)
Leagile	**Information Technology (IT) Integration** Naylor et al. (1999), Mason–Jones et al. (2000), Herer et al. (2002), Scholten et al. (2010)	Lack of IT use (e.g. Thomas & Kopczak, 2005)	Lack of IT leads to lack of coordination (e.g. Careem et al., 2007)	Lack of funding to pursue IT projects (e.g. Thomas & Kopczak, 2005)	Issues about access and power (e.g. Stephens & Ford, 2014)	Slow adoption (e.g. Andresen & Nilsson, 2014)	–
	Supply Chain Flexibility (SCF) Mason-Jones et al. (2000), Herer et al. (2002)	Standardised items (e.g. USAID, 2011) and postponement (e.g. Scholten et al., 2010)	Pre–positioning supplies (e.g. Bozkurt & Duran, 2012)	Resource pooling (e.g. Kovács & Tatham, 2009) and centralised warehousing (e.g. Beamon & Balcik, 2008)	Public–private partnerships (e.g. Thomas & Fritz, 2006)	Standardised items (e.g. USAID, 2011) and postponement (e.g. Scholten et al., 2010)	Identification of high and low priority items (e.g. Holguín–Veras et al., 2012)
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Quick Response	**Partnerships** Christopher et al. (2004), Perry & Sohal (2000)	Limited information sharing (e.g. Day et al., 2009)	Lack of coordination even with centralised coordination agencies (e.g. Gatignon et al., 2010)	Partnerships can compromise independence and monopolise power (e.g. Patterson et al., 2010)	Competition between agencies (e.g. Banomyong et al., 2009)	Corporate partnerships can leverage private sector expertise and efficiency (e.g. Thomas & Fritz, 2006)	Inform public of inappropriate donations through media (e.g. Holguín–Veras et al., 2012)
	Information Technology (IT) Integration Sabath (1995), Perry & Sohal (2000), Christopher et al. (2004), Choi & Sethi (2010)	Lack of IT use (e.g. Thomas & Kopczak, 2005)	Lack of IT leads to lack of coordination (e.g. Careem et al., 2007)	Lack of funding to pursue IT projects (e.g. Thomas & Kopczak, 2005)	Issues about access and power (e.g. Stephens & Ford, 2014)	Slow adoption (e.g. Andresen & Nilsson, 2014)	–
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	Market Sensitivity Perry and Sohal (2000), Christopher et al. (2004), Choi & Sethi (2010)	Information largely inaccessible (e.g. Sheu, 2007)	Information inaccessible (e.g. Sheu, 2007) but limited information sharing (e.g. Kovács & Spens, 2009)	Inform public of inappropriate donations through media (e.g. Holguín–Veras et al., 2012)	Limited information sharing (e.g. Day et al., 2009)	Lack of information visibility (Day et al., 2009)	Inform public of inappropriate donations through media (e.g. Holguín–Veras et al., 2012)

Table 1. Selected Interactions between Characteristics of the Disaster Relief Environment and Agile, Leagile, and Quick Response

Theoretical Foundation

In Table 1, the characteristics of the disaster relief environment are compared to the general antecedents of agile, leagile, and quick response supply chain. What emerges is that there are many approaches from normal time supply chain that would be beneficial for the disaster relief environment as well. Therefore, the ultimate goal is to ensure the feasibility of these techniques during disaster relief. Substantial literature exits on the need and present state of SCC in DRHL (e.g. Tomasini & Van Wassenhove, 2009; Schulz & Blecken, 2010; McLachlin & Larson, 2011). They focus on deploying solutions from SCM (e.g. process and product standardisation in Tatham & Pettit, 2010; centralised coordinating authorities in Lai et al., 2009; increased workflow digitisation and information sharing in der Laan et al., 2009). Seminal research on the topic of information visibility includes Day et al.'s (2009) work on information flow impediments, Schulz & Blecken (2010) on horizontal coordination impediments, and Balcik et al. (2010) on coordination mechanisms in DRHL. Many authors have called for greater professionalisation of the DRHL workforce (e.g. Thomas & Kopczak, 2005) and standardisation of workflow processes (e.g. Jahre & Fabbe–Costes, 2015), as well as numerous means (e.g. pre–positioning supplies in Bozkurt & Duran, 2012) to compensate for the volatility in demand and lead times. Other authors have identified that the competencies of the organisation and personnel directly affect the level of SCC (Akhtar et al., 2012; Moshtari, 2016). From Table 1, research gap in the following areas of DRHL are identified: (1) formation of partnerships; (2) use of information Systems; (3) means of information sharing; and (4) issues of information visibility and accessibility. This paper is ostensibly about developing a communications platform to serve these shortcomings. These issues serve as impediments to the relief project, which presents design challenges to be met with design solutions.

Shortcomings of Current Solutions to SCC and SCV

There are three dimensions to SCC at the operational level (Li et al., 2007): (1) Order quantities; (2) Order synchronisation; and (3) Information sharing which is accurate, timely, and accessible—all three dimensions require information visibility. Many suggested solutions are focused on operations research models with high information visibility needs (e.g. Altay & Pal, 2014; Chiu & Zheng, 2007; Ozbay & Ozguven, 2007), whereas the downstream environment inherently unstable and lacks such visibility (e.g. Day et al., 2009; Kovács & Spens, 2009; Holguín–Veras et al., 2012). For the decentralised structure and stochastic demand, all that is available are mostly, supply chain game models. Balcik et al. (2010) compares various supply chain practices with their suitability to the DRHL, finding that quick response (QR) holds a lot of promise for particularly large NGOs, but it is not currently observed by practitioners perhaps because the risks and technological requirements for implementation are very high. Using a Resource Based View (RBV) suggests that SCV can minimise opportunistic behaviour between NGOs and thereby lead to better SCC (Barratt & Oke, 2007; Brandon–Jones et al., 2014).

Many solutions proposed in the literature imply a technological dependency (e.g. Newaz et al., 2015; Saoutal et al., 2015) that requires widespread adoption (e.g. Kuhnert et al., 2015) in an environment that lacks the funds to procure IS and train users (e.g. Thomas & Kopczak, 2005; Oloruntoba & Gray, 2006; Kovács & Spens, 2009). They avoid any discussion of the inevitable issue of incompatible technologies and need for middleware, or what software programmers call 'dependency hell' (e.g. Radianti et al., 2014). One common approach behind these examples is the attempt to create a common information space (CIS) or common operating picture (COP) where information is visible and shared (e.g. Büscher et al., 2014; Kuhnert et al., 2015; Tatham et al., 2017). Sahana Eden (Careem et al., 2007), an enterprise resource planning (ERP) system, is one example of a highly successful project that enables enterprise resource planning (ERP) in a more user friendly manner and for free compared to commercial offerings, and has seen field implementation (van Gorp, 2014). However, it remains technically difficult to use and requires substantial user training and familiarisation, as well as making two fundamental assumptions: (1) The accuracy and reliability of information can be relied upon, as evidenced by the entry fields offered under Sahana Eden, however this is precisely what is missing in DRHL (Day et al., 2009); and (2) Information standards exist, are comparable across organisations sharing information, whereas there is a lack of common logistics standards in DRHL (Mazzetti et al., 2013). Another successful example is the use of geo–tagged Twitter messages for crowdsourcing disaster reports in the Ushahidi project (Gao et al., 2011) to enable visibility of aggregated disaster reports, though it suffers from the same accuracy and reliability issues as Sahana Eden. The root cause of the lack of SCV and SCC is a lack of logistics standards, yet implementing standards across literally thousands of NGOs appears impracticable. These shortcomings serve as the motivation for the ultimate research objective: To enable SCV and SCC in DRHL through a systems architecture design that complements the unique nature of the DRHL environment.

Design Challenges and Design Approach

A conceptual model, (Figure 1) is formed to incorporate the identified design challenges and potential design solutions into the systems architecture.

Highly Decentralised Environment → Decentralised P2P Mesh Networks

The first design problem encountered was how to support inter–organisational SCC, given the highly fragmented nature of the humanitarian sector, with thousands of individual humanitarian organisations communicating in an ad hoc manner (Holguín–Veras et al., 2012). Additionally, whenever talking about communications networks there are the issues of access, equality, and power (e.g. Büscher et al., 2014). There has been much literature on creating a common information space (CIS) for aid agencies to communicate (e.g. Kuhnert et al., 2015; Tatham et al., 2017), but that assumes mass adoption and runs up against issues of differences in language and culture (e.g. Büscher et al., 2014). One potential solution is to use decentralised peer–to–peer (P2P) mesh networks for complementary side channel communication. A decentralised network does not have a central authority and instead coordinates amongst many nodes using a common set of policies. A mesh is a particular type of decentralised network where each node can connect to any other, provided it is within range, so that each node can act as a transmitter, receiver, router, and any other type of entry and exit node. By 'complementary' side channel communication, the systems architecture is referred to as complementary, not exclusive, to existing communications networks. It is provided in addition to, not instead of, existing networks for the purposes of metadata capture and analysis.

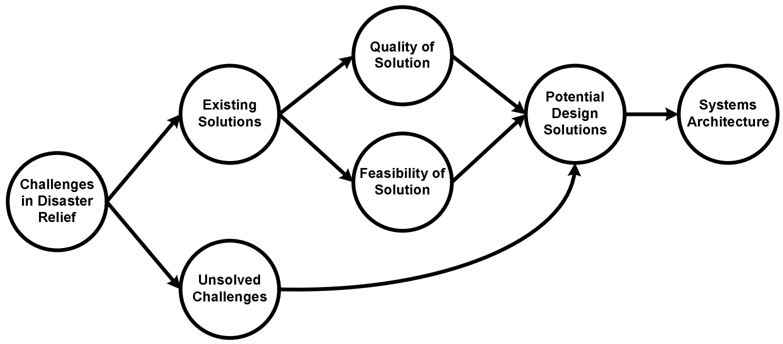

Figure 1. Conceptual Model for Integrating Design Problems and Solutions into the Systems Architecture

Unwillingness to Share Information → Selective Information Sharing

Unwillingness to share information and the propensity to leverage personal and ad hoc relationships for what little information sharing occurs presents a design problem for a systems architecture that purports to support information sharing. (There is opposing literature suggesting 'swift trust' between aid agencies as an important antecedent of SCC (e.g. Tatham & Kovács, 2010) arising out of practicality, but it remains to be seen what level of trust exists in this often highly politicised environment). A potential solution is to include support for terms of agreement for selective information sharing. This allows each aid agency to set the terms of involvement (e.g. what to share, how much to share, whom to share it with) and tailor their sharing with their experience and trust in other agencies, instead of a 'one size fits all' or an entirely ad hoc approach. Additionally, beyond the explicit sharing of information data mining can be used to retrieve then aggregate metadata from individual agencies. This data can be anonymised by stripping it of identifying information and only showing the aggregate values across the entire network, which strips it of some of its context but allows for macro level observations. It would be expedient for this process of setting terms for information sharing to be standardised and automated as much as possible, as opposed to being bogged down in negotiations on legal and political matters in the midst of a disaster relief operation. Currently, information sharing is either broadcast from a central authority or organised as ad hoc agreements between individuals across agencies (Holguín–Veras et al., 2012).

Support Staff Required for Setup, Maintenance, and Repair → Autonomous Operation

The problem of requiring a significant staff complement for network setup, maintenance, and repair can be solved by making the network largely, if not entirely, autonomous. The aim is to minimise human interaction to only what is necessary to input data into the network. Any solution should support aid agencies in their efforts, instead of forcing them to fight with the technology. There are several aspects to autonomy in the systems architecture: (1) Data conversion; (2) Message frame assembly; (3) Router; (4) Network analytics; and (5) Maintenance and repair operations (MRO). Data translations involve converting everything to a single data standard (e.g. .CSV files) in preparation for the messaging frame assembly, which in turn reassembles the data into a message frame containing the original message along with pertinent message information (e.g. origin and destination of delivery, whether this is part of a multi–part message, does it contain any information pertinent to analytics). By having a programming script automate data conversion and message frame assembly through the user interface (UI) when typing a message, the user does not have to know or operate any technical details about the network to be able to input and receive output data from the network.

Routers search for paths across the network and reroutes data packets for more efficient distribution. Autonomous self–healing mesh networks periodically remap all the routes across the entire network, allowing them to reroute messages around damaged nodes. Network analytics are typically packaged with routers to analyse network traffic, but can also be configured to capture packet information, automatically anonymise any identifiable features (e.g. origin, destination, and certain contents) and only present aggregate figures. This allows network analysis without human input, such as areas of high activity, shortages of resources, and requirements for new nodes. Maintenance and repair operations (MRO) includes updating the software across the network (i.e. patching), and repairing and replacing damaged nodes. If each basic node is low cost and comes in high volume, it may be cheaper to simply let a damaged node fail and put up another one than to repair it. Since the network is an autonomous self–healing mesh, updates can be pushed across the network from a central location to propagate as a message (e.g. nearby nodes update each other's driver software), whilst damaged nodes will automatically be rerouted around so as to not break connectivity. This leaves MRO almost entirely autonomous and low effort, even for the one administrator required initiating the patching process. Conspicuously, existing solutions do not mention (lack of) autonomy or the need for a support staff (e.g. Kuhnert et al., 2015), raising the question of the technological expertise required to operate the network and whether it is feasible in the disaster relief environment.

Network Scalability → Network Nesting

The problem of scalability is significant for a mesh network, particularly one that is largely autonomous. Because each node in an autonomous self–healing nesh network must periodically contact every nearby node to construct a network map, there is a practical limit to the size of a mesh network. The fundamental issue remains the more nodes there are the higher the upkeep for each node. One solution is to use network nesting (i.e. networks within networks) to increase network scalability beyond the practical limits of only using a single network. Network nesting is a common solution to the practical problem of scalability. Operations within each nested node would function independently as a mesh network, whilst links between nested networks would function as high speed information lanes.

Dependency Hell → Encapsulated Dependencies and Multi–Platform Support

Every technology has dependencies which without the technology will not function. In software programming, the seemingly ever–changing software dependencies on different platforms and running environments is referred to as "dependency hell". When different organisations with different procurement processes try to coordinate their efforts using different technologies, incompatible technologies inhibiting coordination is quite common (Turoff et al., 2014). The solution is to encapsulate all dependencies in a single installation package, including support for multiple platforms.

Methodology

The chosen methodology is design science research (DSR). By Meredith et al.'s (1989, p.309) taxonomy of research methods, this research is positivist and artificial. Using Nunamaker Jr., et al.'s (1991, pp.92–98) multimethodological approach to information systems design, there are a series of stages to information systems design. First, the literature is surveyed to build theory on the antecedents of supply chain visibility, information sharing, and supply chain coordination, and then compared to DRHL. In the conceptual model and systems architecture definition phase, the system requirements are defined and organised into modules, which are then integrated and expressed as a systems architecture defining the functionality of each module and their linkages. Subsequent phases will be covered by separate research papers.

Systems Architecture

Out of the design problems and chosen design approaches above, systems architecture for supporting supply chain coordination is defined. The central argument to the systems architecture is that logistics standards are unlikely to be implemented across all the NGOs responding to a disaster, particularly the smaller NGOs, and SCC is primarily hampered by a lack of information visibility from an unwillingness and inability to efficiently share information, therefore some SCC mechanism is required to deliver information visibility without the need to centralise information sharing through a centralised coordination authority or by common logistics standards. The metadata component of the systems architecture allows insights into the data without NGOs specifically sharing data. The architecture is generic and non–specific to any one type of technology or data standard. It does not attempt to advocate any particular technology, though some standards may be deemed more suitable than others. The resulting prototype built from this systems architecture as a proof of concept is only an example of implementation—it does not purport to be the only one. (There are many other approaches of implementation and for reasons of simplicity this author simply had to pick one.) The systems architecture is composed of several mutually supporting modules encapsulated within each node. This means that each node can act as a transmitter, receiver, router, and coordinator, i.e. each node can perform any of the functions necessary to operate the network. Although the nodes themselves do not have to be homogenous (e.g. some may be configured to a particular data communications standard than others), they must contain all elements of the systems architecture.

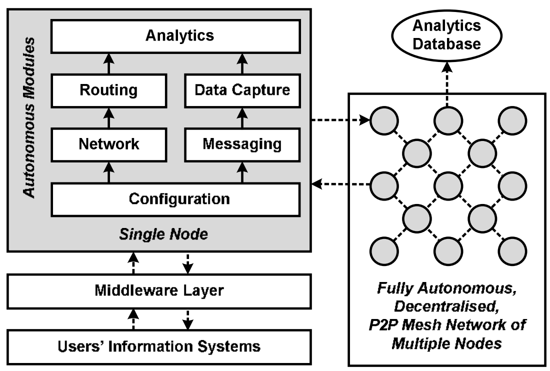

Figure 2. Systems Architecture for Supporting Supply Chain Visibility and Supply Chain Coordination in Disaster Relief Humanitarian Logistics

Systems Architecture Components

Configuration Module: The configuration module is an autonomous setup procedure that is triggered whenever the device is turned on, causing the device to update its software from the rest of the network, broadcast its location, receives the locations of other nodes, and becomes ready to receive and transmit messages. Additionally, the configuration module automatically broadcasts software updates and each node propagates the updates through their individual connections in the network.

Analytics Module: This is an autonomous module that automatically retrieves information from agencies at each node, anonymises the information by stripping it of information that can be used to identify its origin or overly specific details about its contents, and then aggregates individual data and to create aggregate metadata to describe network activity. This metadata is broadcast publically to all in the network, allowing users to identify areas of high activity, congestion, and shortages.

Messaging Module: This is an autonomous module that handles all messaging functions that allow nodes to communicate with one another. This includes message (dis)assembly (e.g. message frame) to include pertinent metadata (e.g. code words, sequence of a multi–frame message, origin and destination).

Network Module: These are the technical components to information transmission and reception within a network (e.g. Wi–Fi, satellite communications, GSM mobile phone).

Routing Module: This autonomous module governs the order and paths in which data packets in the network are routed to maximise efficiency. The Routing Module includes the ability to create a self–healing (autonomously (re)routing) mesh network, meaning if any nodes go offline the rest of the network will find paths around it using the remaining online nodes.

Data Capture Module: This module automatically pulls information through content analysis (e.g. analysis of .XLS and .CSV spreadsheets) and uploads them to the analytics module as metadata. The script module also contains individual organisational and user preferences as to what information they wish to share and whether it should be anonymised.

Key Assumptions

The systems architecture makes several key assumptions, which pose design challenges in the implementation phase: (1) Ease of adoption is high, given that in DRHL adoption if typically slow and risk adverse (Andresen & Nilsson, 2014); (2) Partial adoption is sufficient to deliver value, as it is unreasonable to expect full adoption by all parties (cf. Andresen & Nilsson, 2014); (3) Cost of adoption is low, given that there is a lack of funding for procurement (Thomas & Kopczak, 2005); (4) Costs of training, operation, maintenance, and repair are low, given there is a lack of funding for training and hiring (Thomas & Kopczak, 2005); (5) Proposed solution will complement other solutions, otherwise they would simply increase the administrative and technological overhead; (6) Proposed solution will not 'crowd out' other solutions (i.e. in addition *to*, not an alternative *of*); and (7) There exists a common data standard across organisations (e.g. .XLT, .XL, .XML and .CSV spreadsheets, and .DOC, .DOCX and .PDF forms). If these assumptions do not hold, the project will be a failure. It is important to explicitly state what the systems architecture is not: (1) Mere application of a mobile ad hoc network (MANET) to humanitarian logistics, application of analytics to MANETs, application of operations research (OR) heuristics to network traffic, or the mere application of any of its constituent components in isolation.

Conclusion

The main issues in supply chain coordination in humanitarian logistics during disaster relief is the lack of information visibility, which consequently limits information sharing and supply chain coordination, and the lack of technological facilitators. The proposed solution can be understood as a lightweight communications network that is complementary to existing systems, but with the following crucial differences: (1) Users can share information conditionally and set the terms; (2) Information can be easily shared within and across organisations; and (3) Automatically anonymised metadata is available to everyone. The systems architecture functions as a decentralised, self–healing mesh network using peer–to–peer (P2P) protocols, which allows the network to configure, operate, and repair autonomously. The contributions of this paper are as follows: (1) Synthesis of seminal literature on agile, leagile, and quick response into a comparison of environmental challenges and solutions (if any) to implementing each supply chain strategy; (2) Using that synthesis to identify design problems and potential design approaches to systems architectures for communications platforms in disaster relief; and (3) Defining a systems architecture for enabling quick response in the disaster relief environment.

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